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Fact Sheet

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DIURNAL ICE STORAGE (DIS) COOLING SYSTEMS DEMONSTRATION

The Problem

Utility rates during periods of peak energy demand are substantially more than at other times of the day. At a typical Army installation, 1/3 to 1/2 of the total electric bill is accumulated during these peak hours. Cooling a building during daytime summer hours can be expensive because utility companies must bring additional, more costly generating equipment on-line to handle the increased load. Companies then assess a peak demand charge for users who contributed to the increased peaking load.

The Technology

Diurnal ice storage (DIS) is an effective technology for reducing the electrical-demand charge for facility air conditioning. DIS cooling systems use electricity during off-peak hours to operate cooling plants. They make ice at night and store it to cool buildings during the next day's peak hours. DIS is a form of latent heat storage that uses the fusion energy associated with the water-to-ice phase change. Several types of ice storage tanks are available commercially in sizes ranging from 12 to 1200 ton-hours.

There are three different DIS methods: 1) a “full storage” system in which the chiller does not operate during the day because DIS generates and stores enough ice to cool the building adequately during the on-peak period, 2) a “partial storage” system in which the chiller operates continuously during the day but gets part of its energy from DIS, and 3) a “demand limiting” system that turns the chiller off during the peak period and relies on DIS when rates are the highest. Most typically, the demand limiting systems are the most cost effective applications for the Army installations.

Benefits/Savings

DIS cooling systems for air conditioning reduce the amount of electricity used during utility peak hours, thus reducing electrical-demand charges. In some instances, the peak demand charge constitutes as much as 50 percent of the electrical utility bill. The DIS cooling system installed at Fort Stewart, GA, has reduced the base electrical-demand charge by about $10,000 per year. Fort Bliss, TX, has saved $12,000 per year in demand charges with its system. The annual savings from the DIS system at Yuma Proving Ground, AZ, is about $22,450.

Status

The U.S. Army Construction Engineering Research Laboratory (CERL) has demonstrated three generic types of the DIS technology: an internal melt ice-on-coil system at Fort Stewart, GA an external melt ice-on-coil system at Yuma Proving Ground, AZ and an ice harvesting system at Fort Bliss, TX.

In April 1987, an internal melt ice-on-coil DIS cooling system was installed for the Main Exchange Building at Fort Stewart. The system reduced the peak electrical demand of the installation by 120 kilowatts. Due to severe freeze damage to the system (burst of condenser loop and moisture migration into compressors through refrigerant coils) and subsequent degradation of the system's performance, the system was decommissioned in October 1993.

In October 1988, an external melt ice-on-coil DIS cooling system was retrofitted to a barrack/office/dining hall complex at Yuma. The system has reduced on-peak electrical demand there by 150 kilowatts. The Arizona Public Service provided $37,500 to CERL -- which funded the Yuma system -- as part of their thermal storage incentive program. The system has been operating as designed up to now. The success of the system has been featured in a 1993 videotape as part of the Facilities Engineering Applications Program.

In October 1990, an ice harvesting DIS cooling system began cooling a dental clinic at Fort Bliss. The system has been designed to shift 53 kilowatts of electrical demand to the off-peak period. Performance was monitored during the last days of the 1990 cooling season. The system experienced an oil circulation pump failure in the compressor.

A number of technical papers have been published in conjunction with DIS cooling system demonstrations. These papers, as well as engineering drawings and bid specifications for each system, are available to Army engineers through CERL.

Point of Contact

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